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Chang et al.

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(54) **NON-BACKLIGHTED ILLUMINATING KEYPAD**

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(51) **Int. Cl.**
H01H 9/00 (2006.01)

(52) **U.S. Cl.** **200/314**

(58) **Field of Classification Search** 200/314, 200/512, 269, 448, 310

See application file for complete search history.

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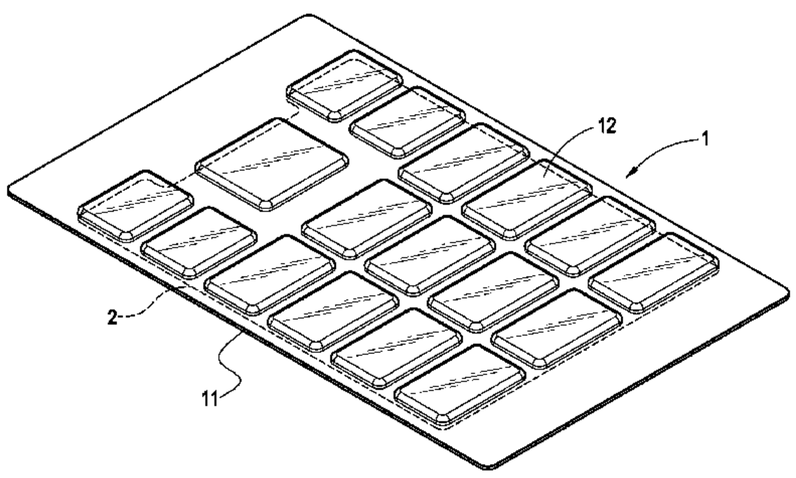
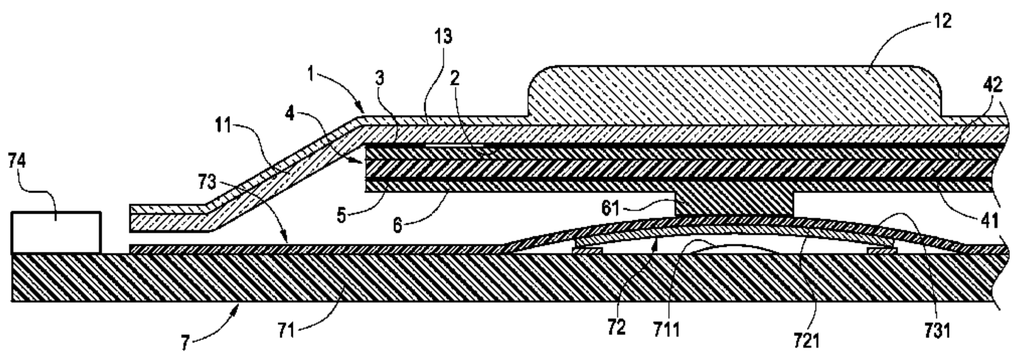
(57) **ABSTRACT**

A non-backlighted illuminating keypad includes a keypad panel, a light gathering layer, an electronic ink layer, a first elastic layer and a switch board. The keypad panel includes a carrier and a plurality of keycaps arranged on the carrier. The light gathering layer is arranged on a bottom surface of the keypad panel and located corresponding to the keycaps. The electronic ink layer is arranged on a bottom surface of the light gathering layer. The first elastic layer is arranged on a bottom surface of the electronic ink layer and comprises a plurality of protrusion portions respectively corresponding to the keycaps. The switch board is arranged below the elastic layer.

12 Claims, 15 Drawing Sheets





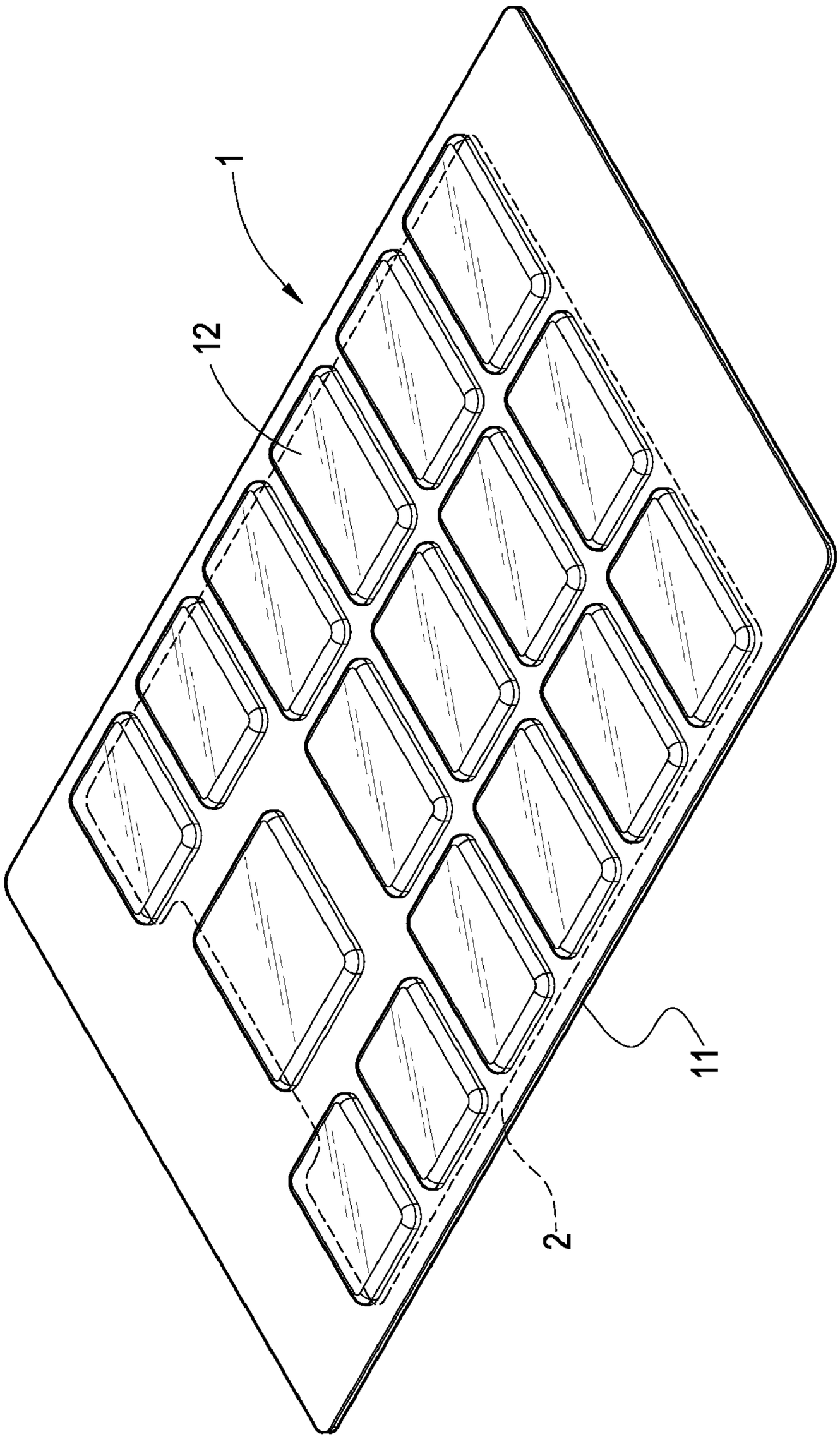


FIG.1

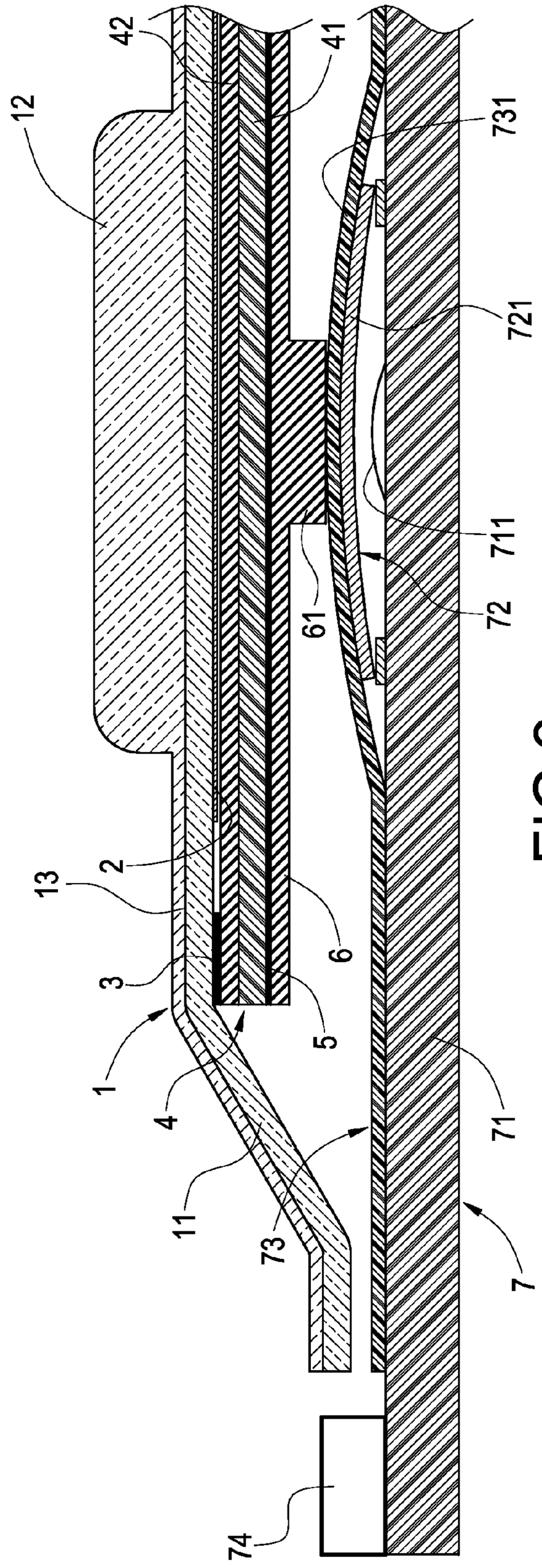


FIG.2

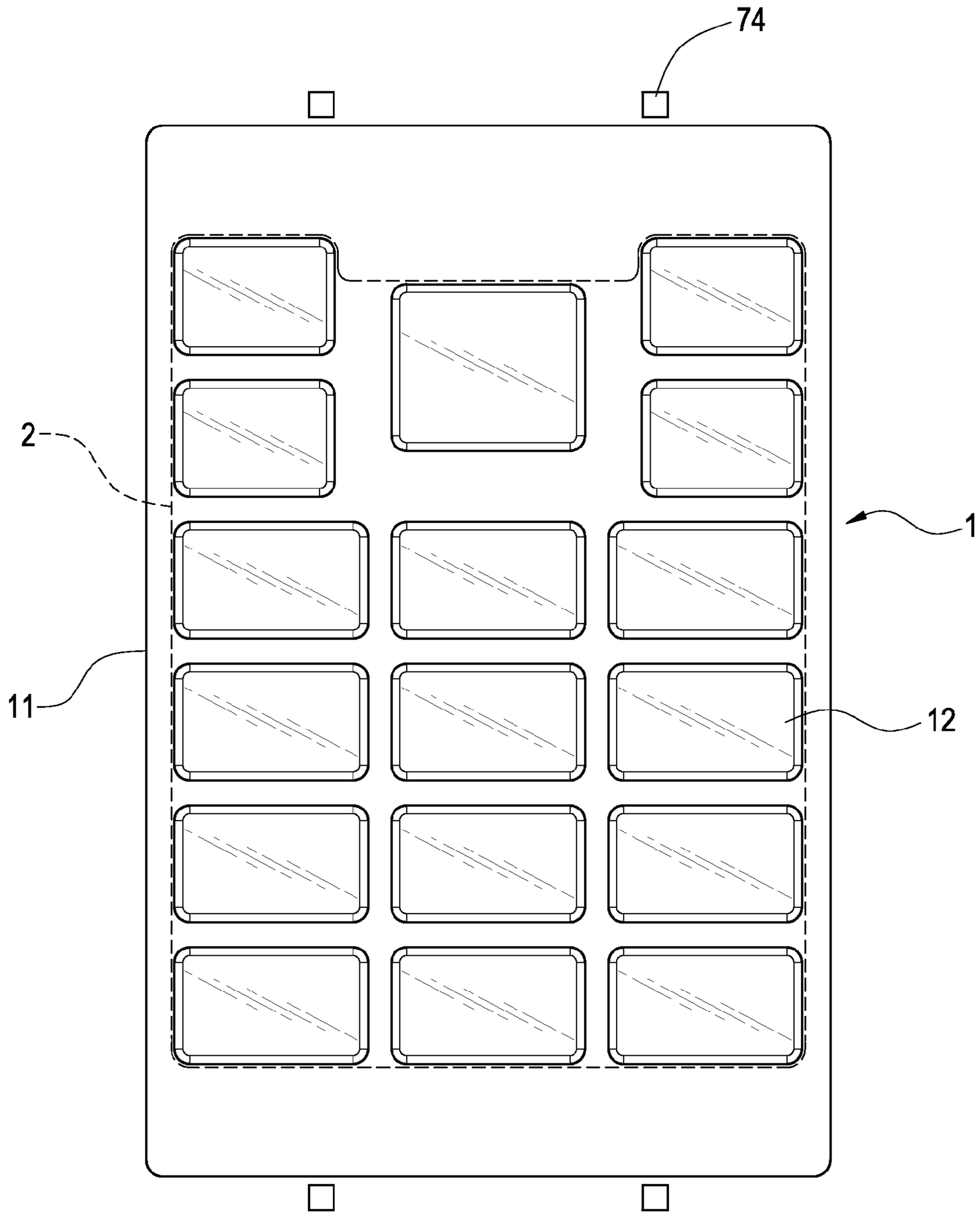


FIG.3

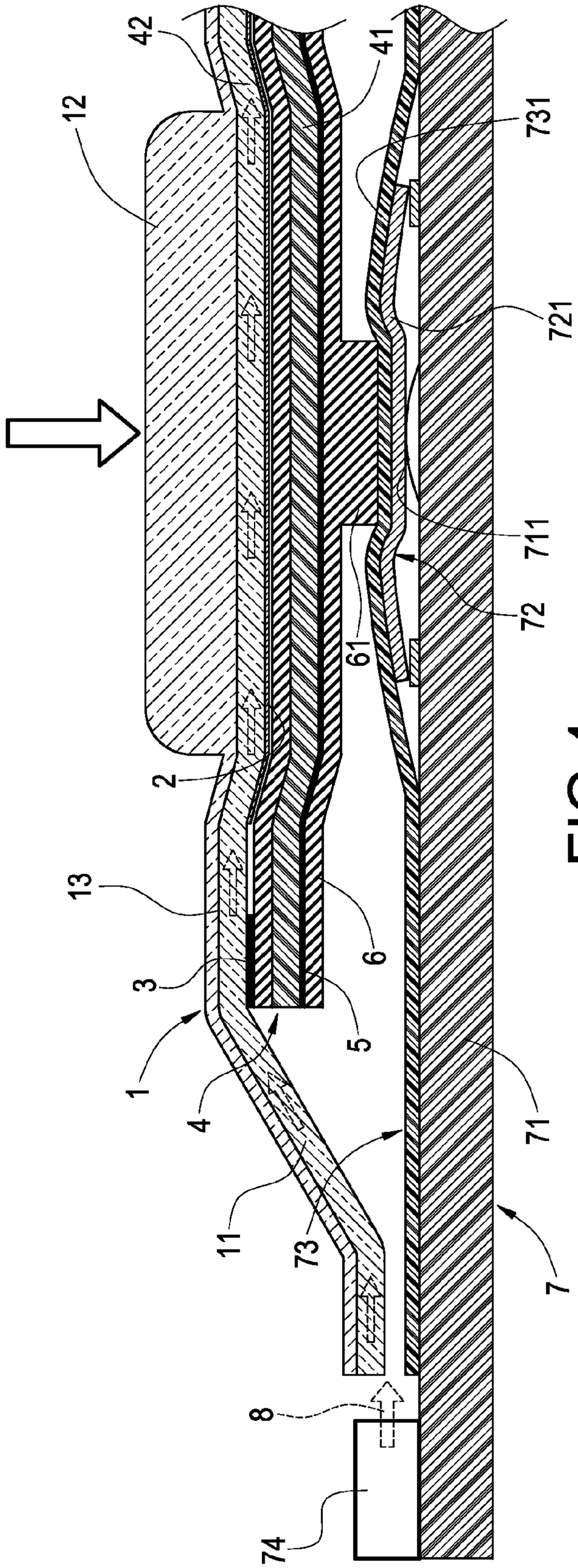


FIG.4

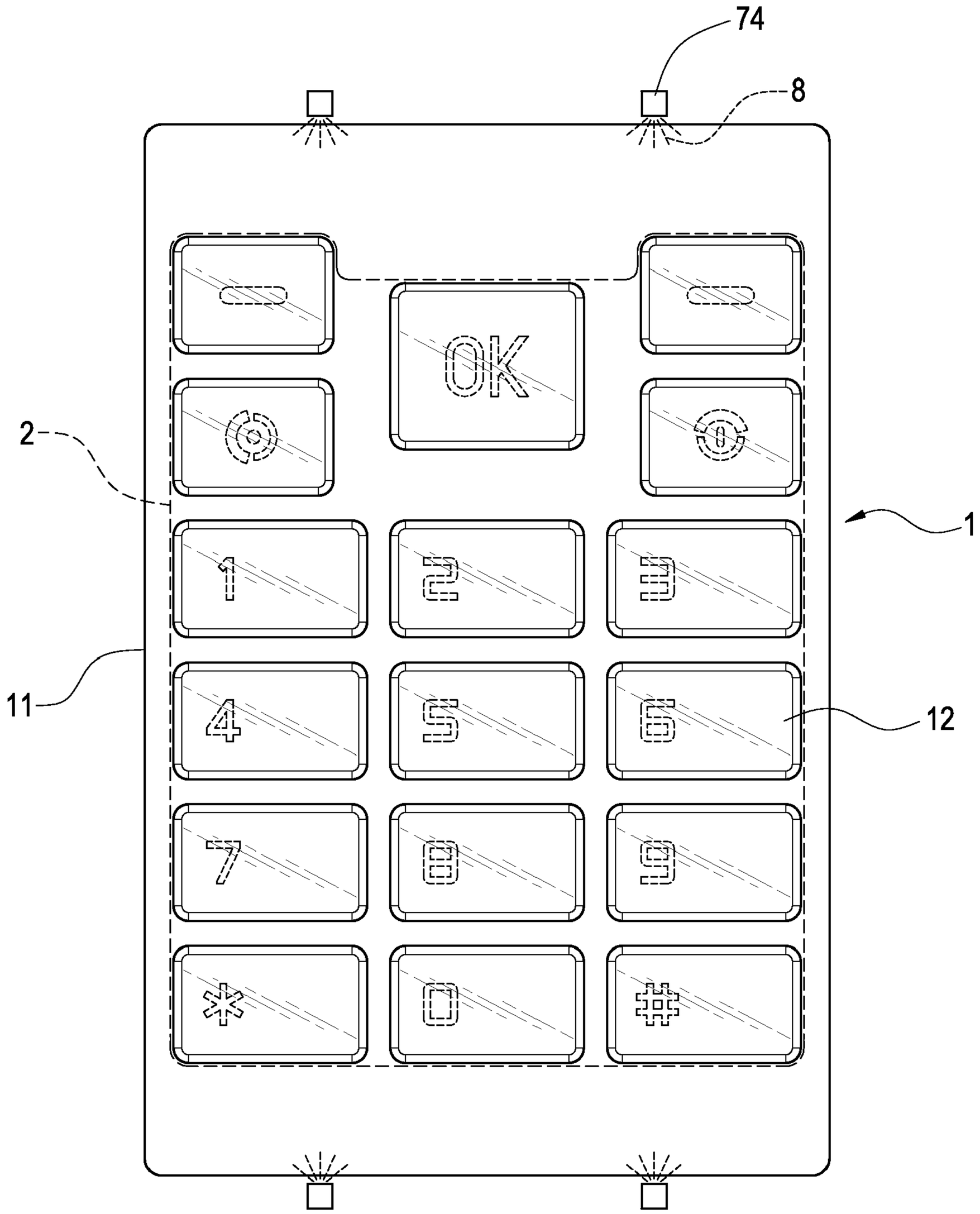


FIG.5

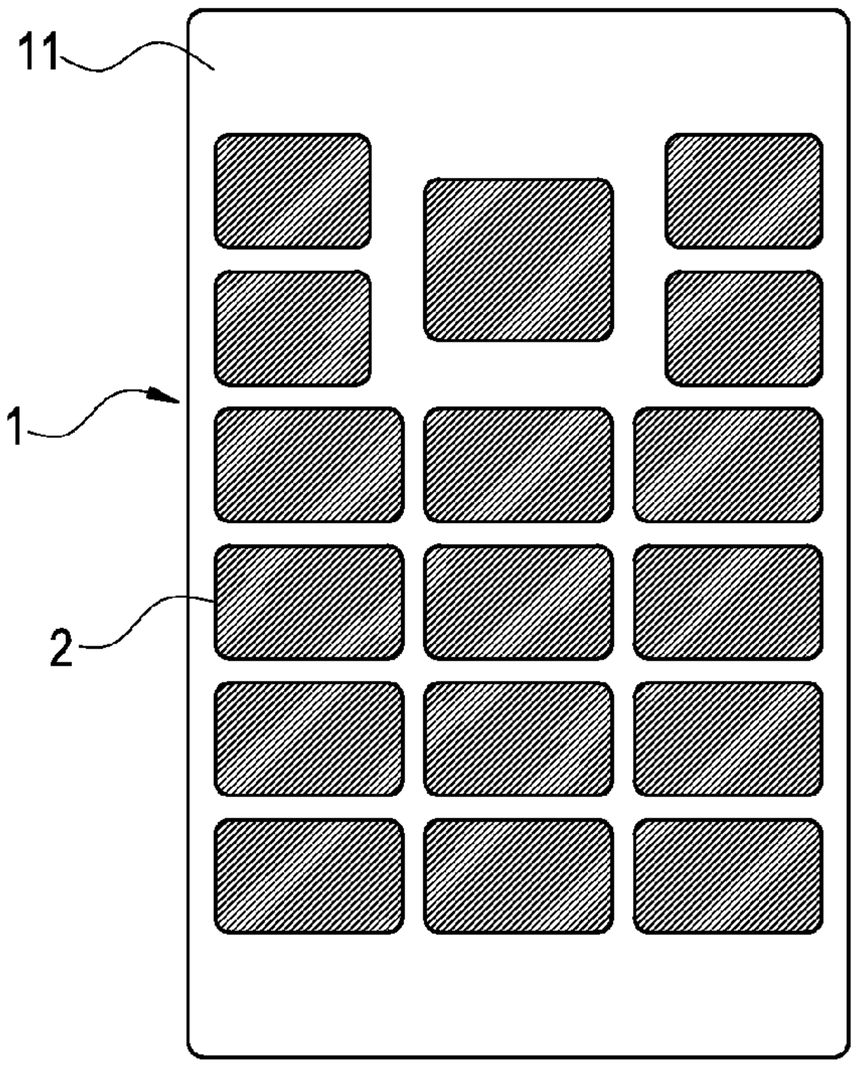


FIG.6(a)

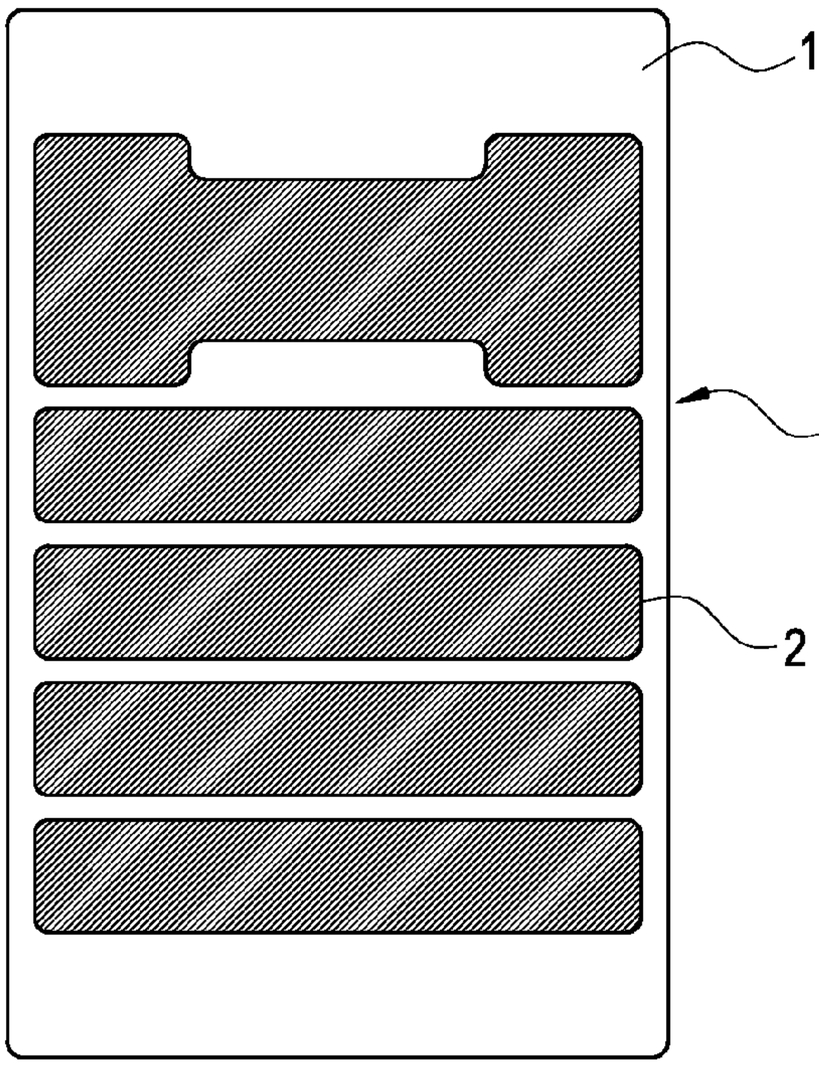


FIG.6(b)

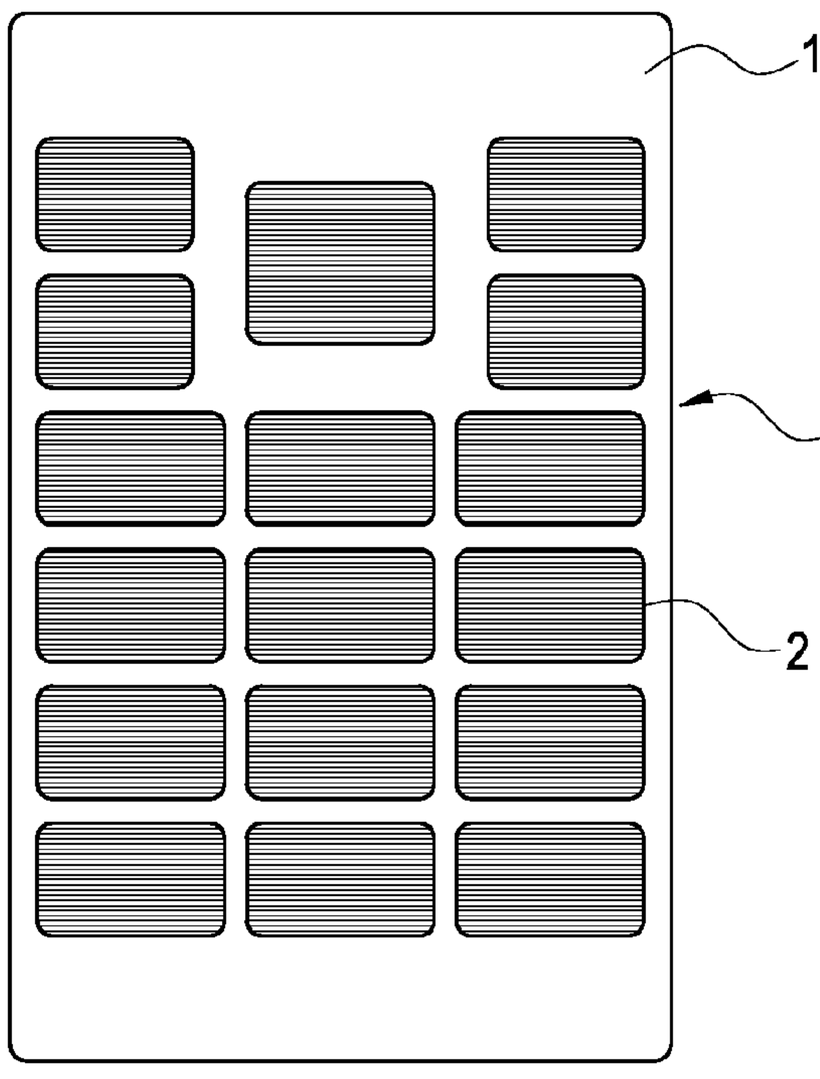


FIG.6(c)

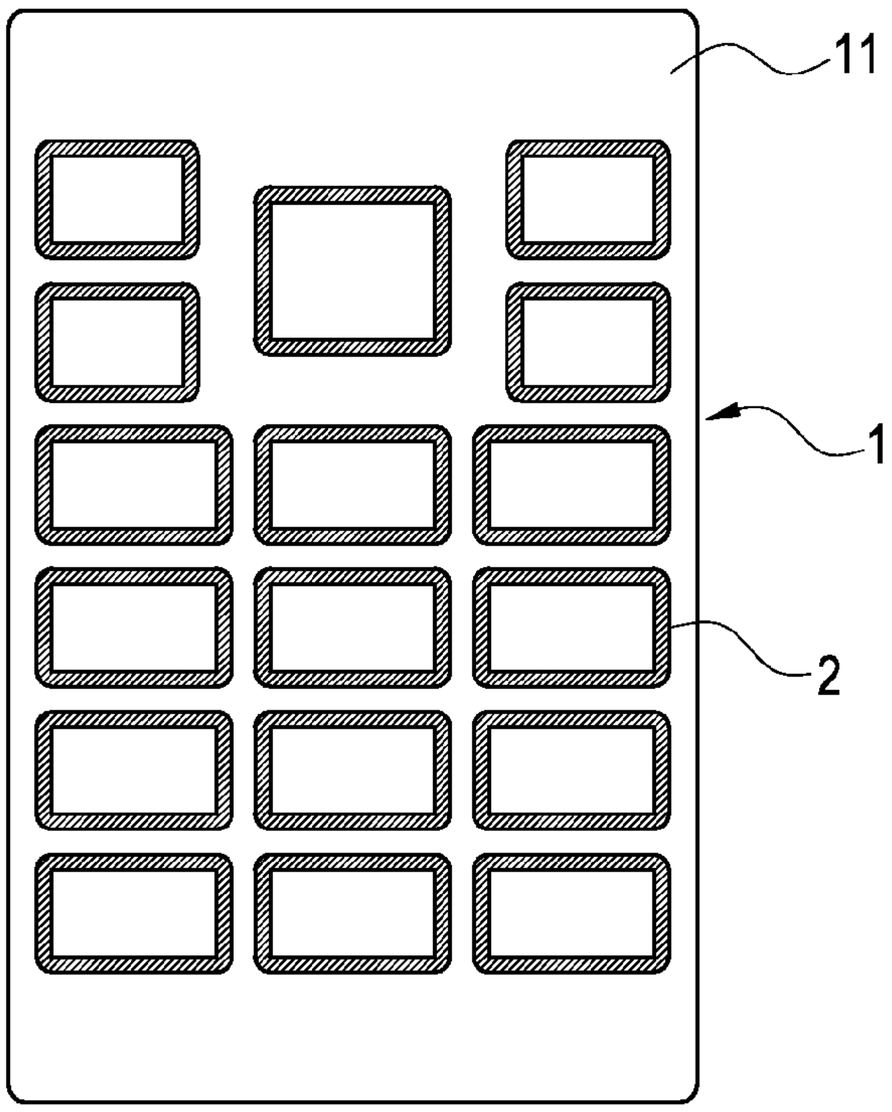


FIG.6(d)

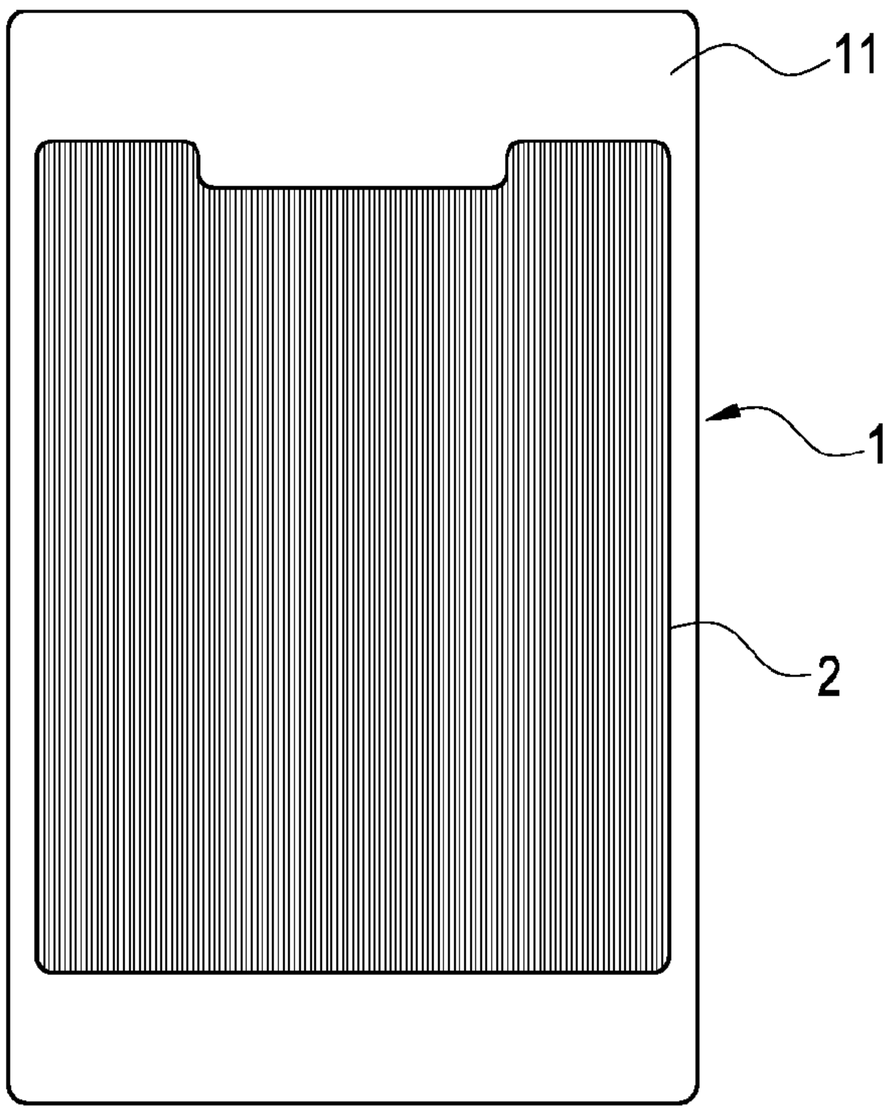


FIG.6(e)

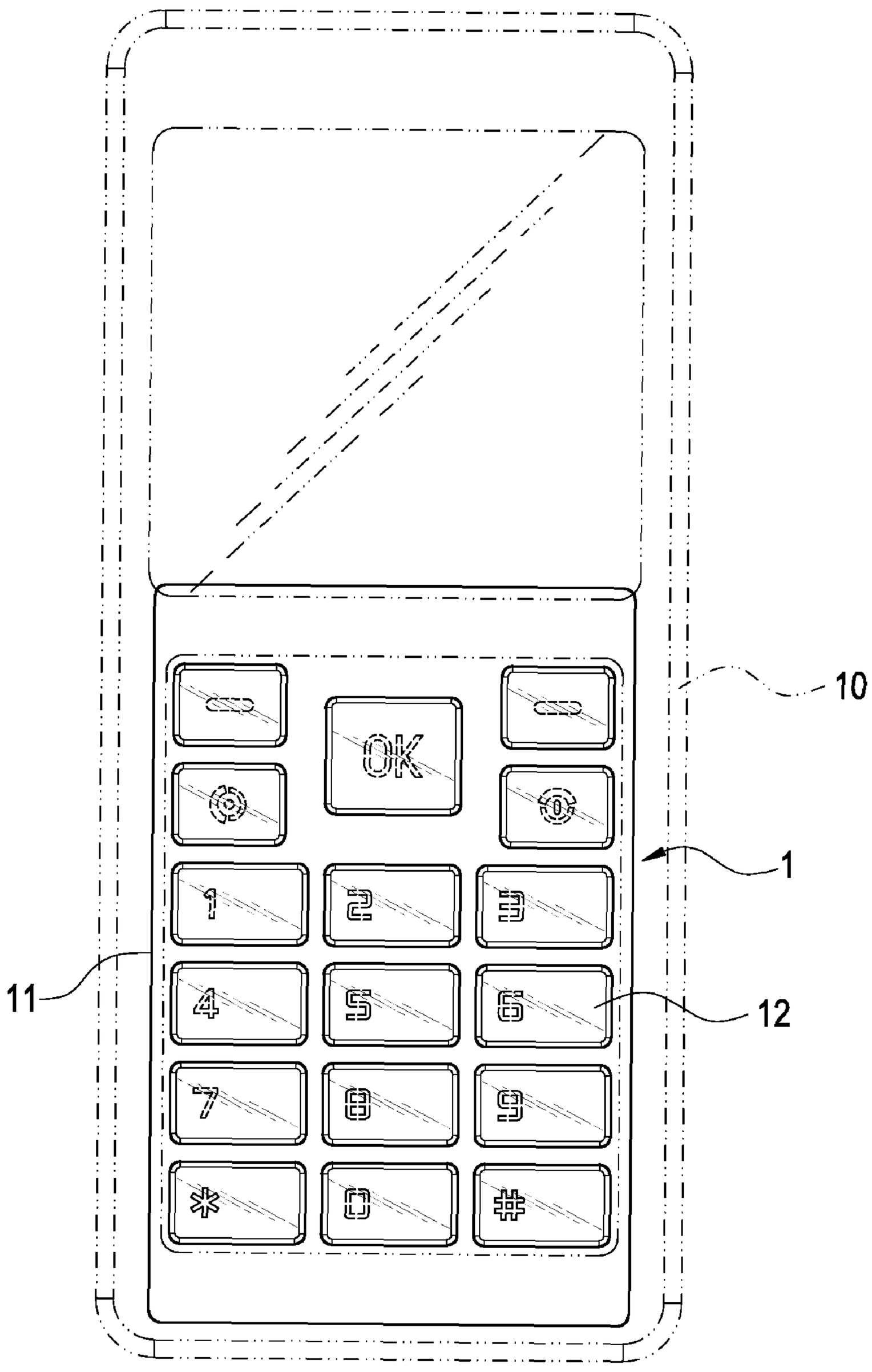


FIG.7

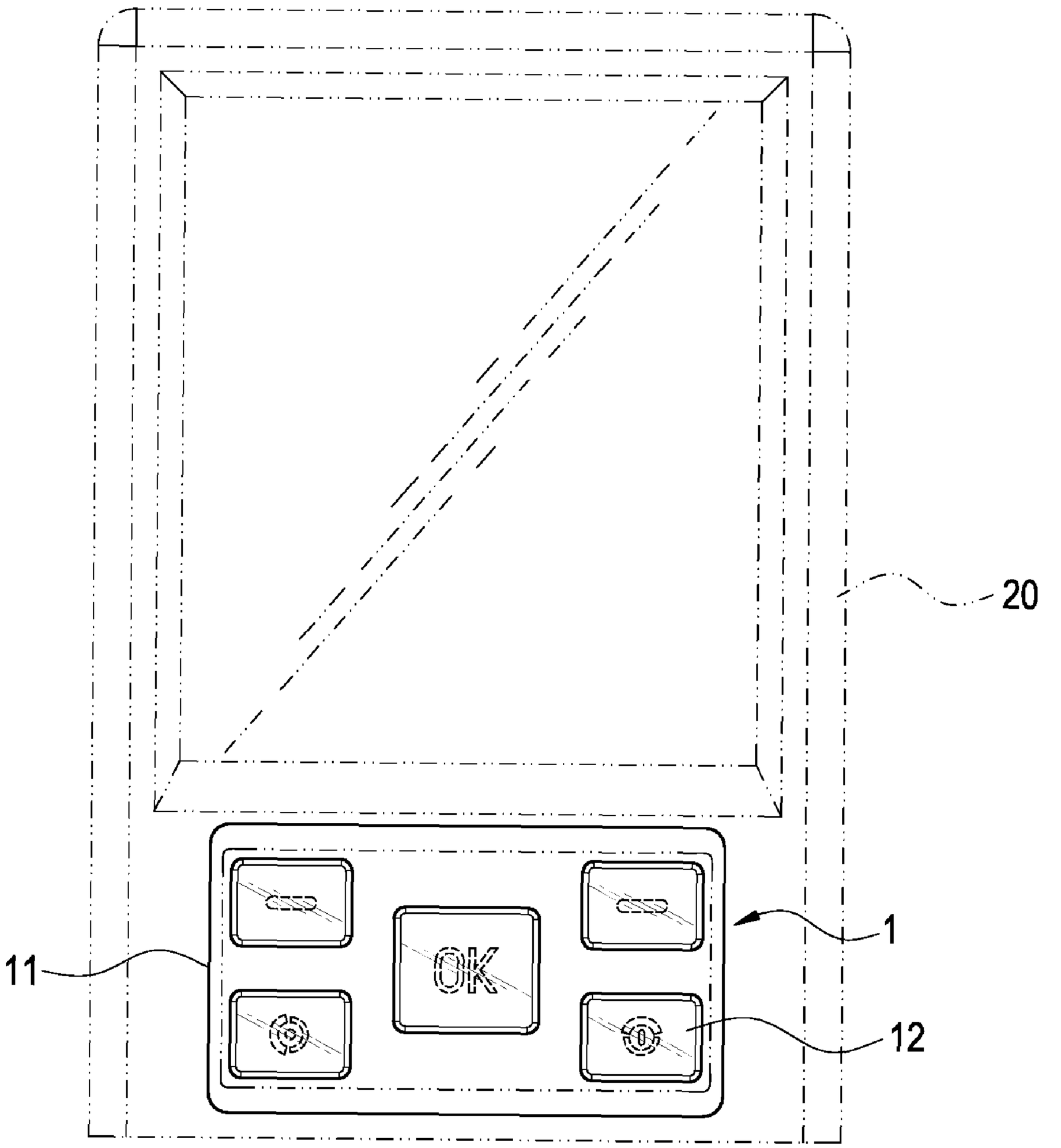


FIG.8

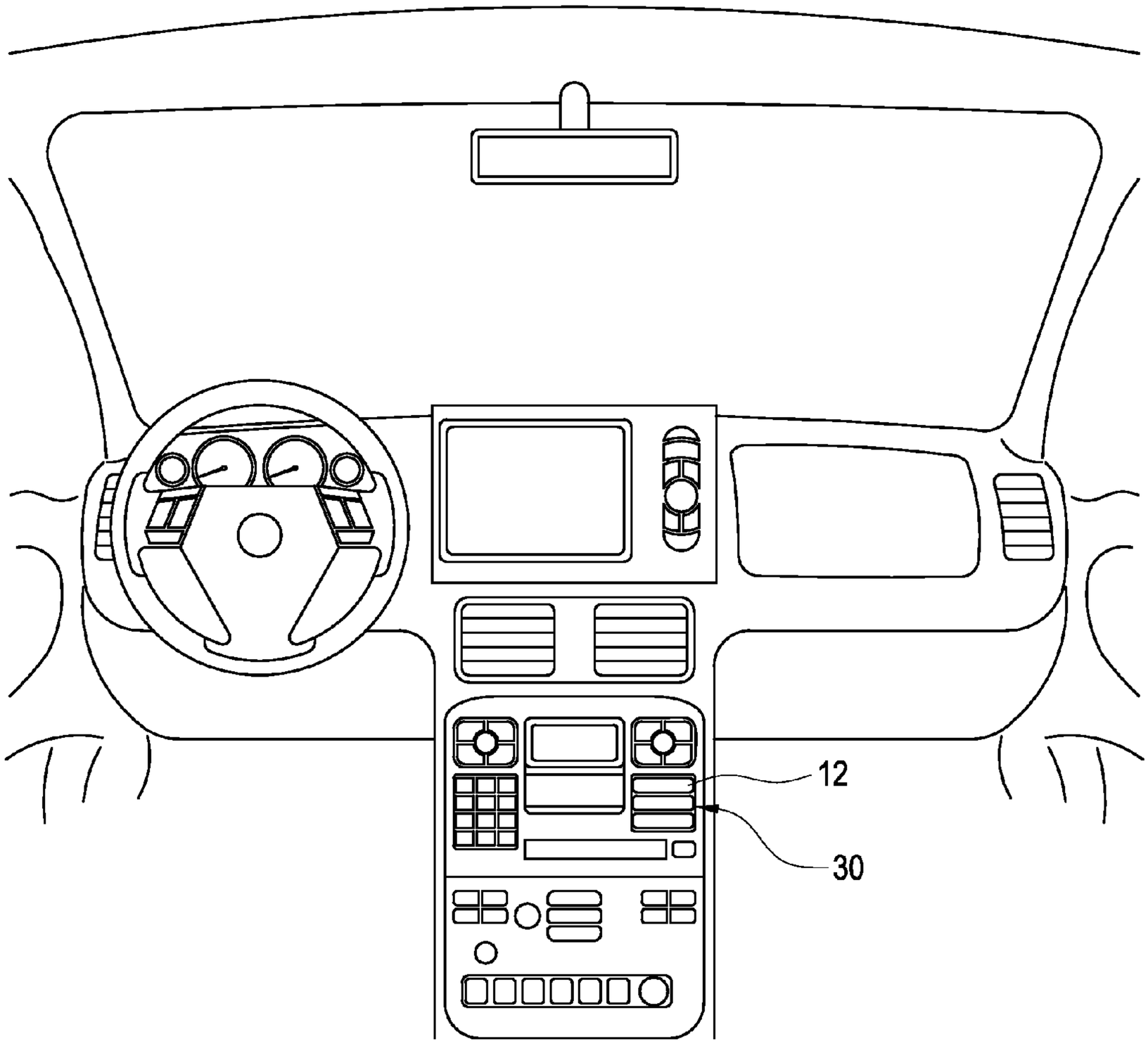


FIG.9

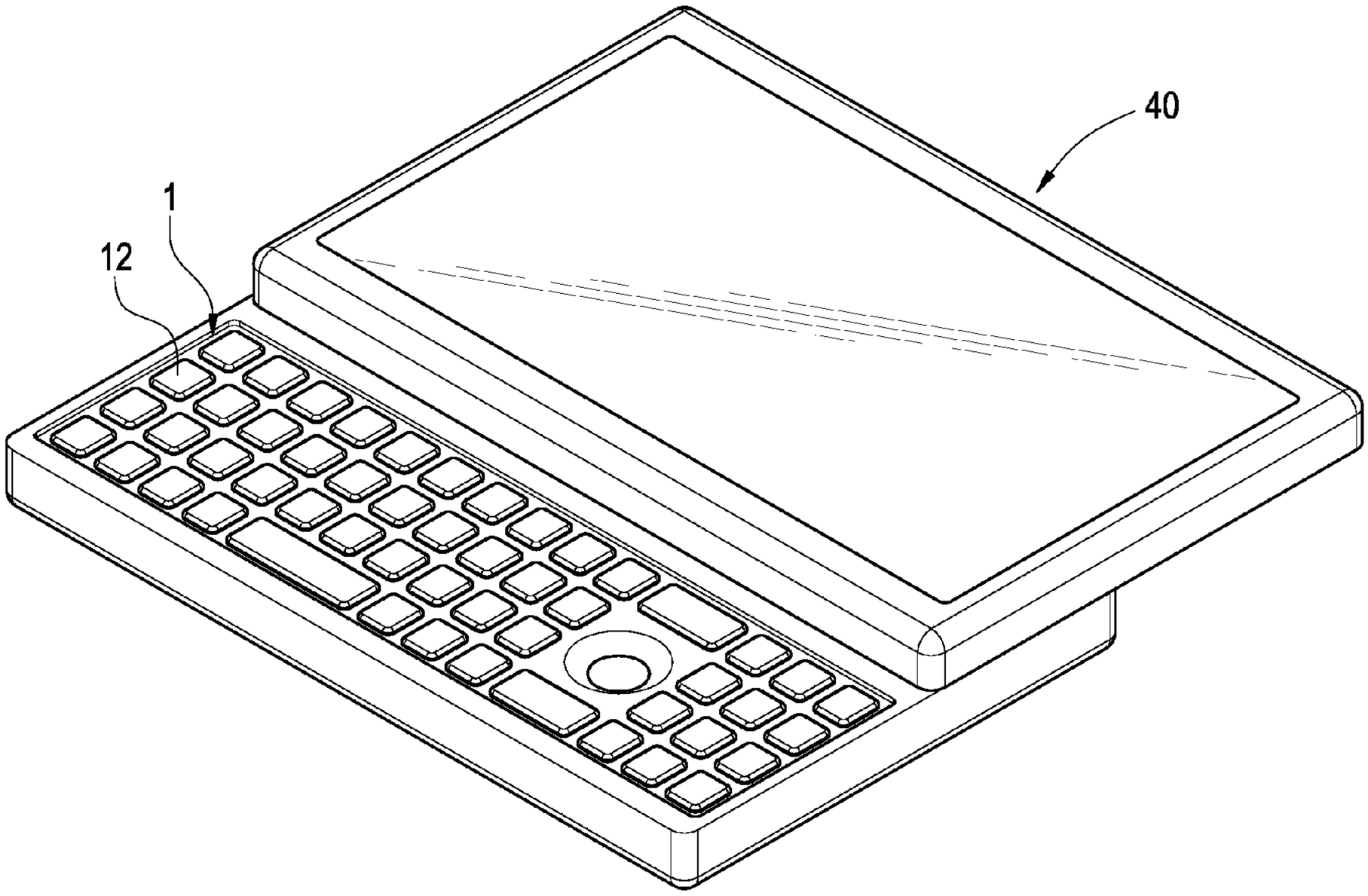


FIG.10

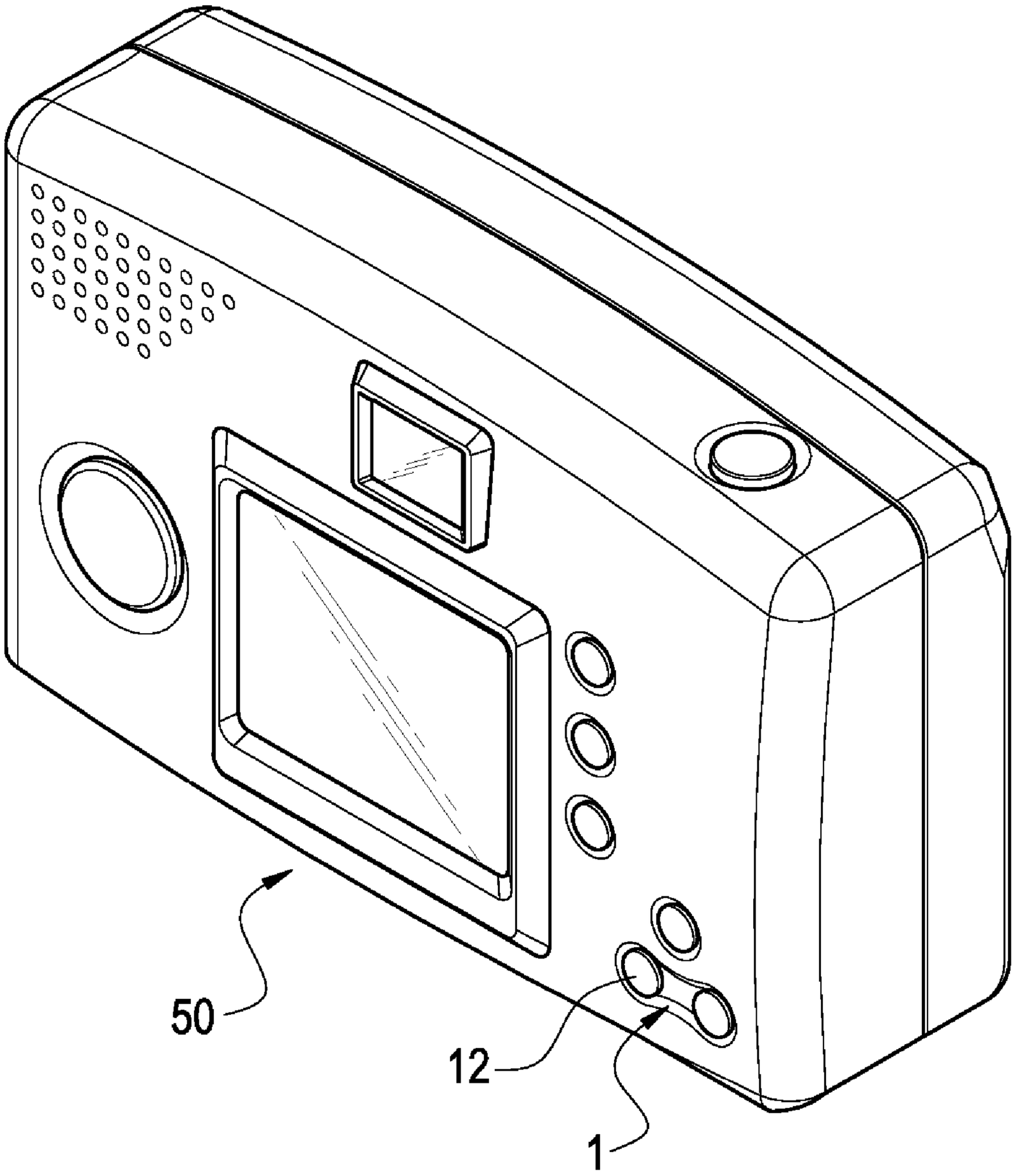


FIG.11

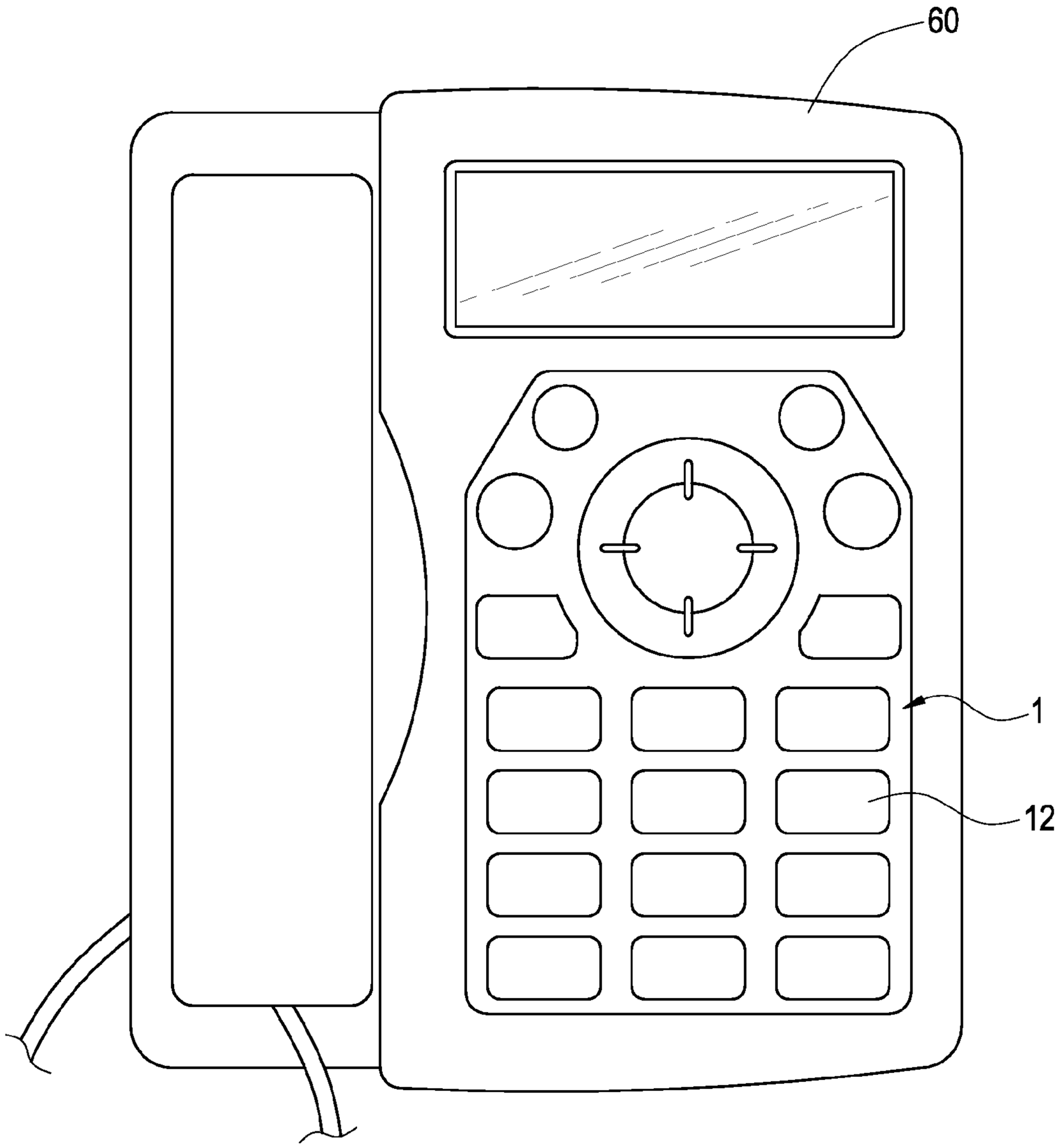


FIG.12

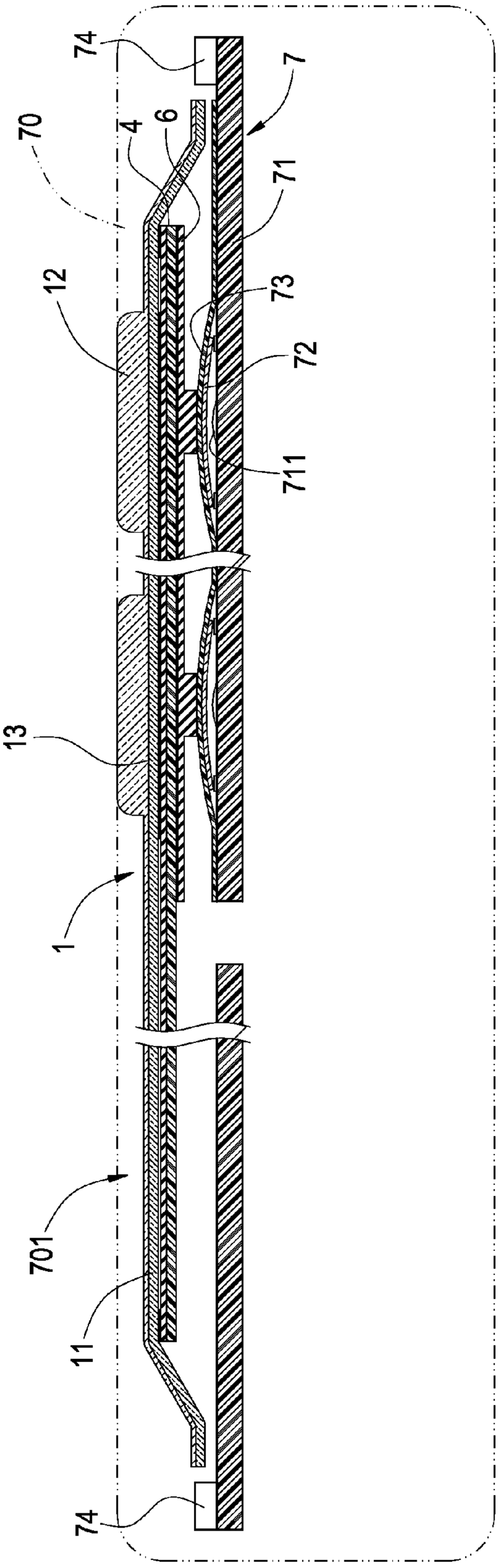


FIG.13

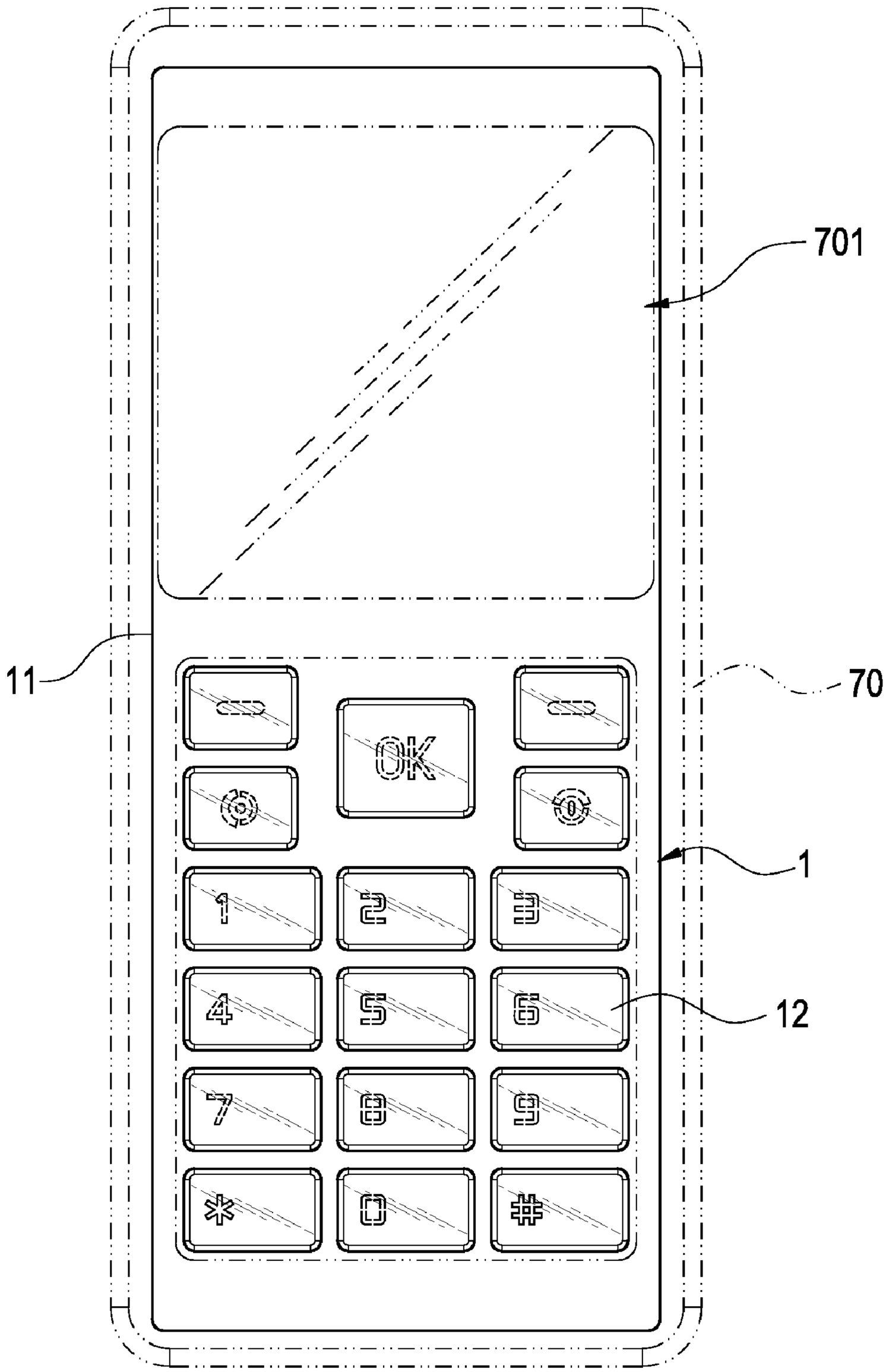


FIG.14

NON-BACKLIGHTED ILLUMINATING KEYPAD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a keypad, in particular to a non-backlighted illuminating keypad.

2. Description of Related Art

Backlight module is extensively used as a light source in liquid crystal display, advertising apparatus and portable electronic devices. In a portable electronic device such as cellular phone or personal digital assistant (PDA), the light source is often arranged behind a keypad panel to provide light penetrated through the keypad panel to illuminate the numerals, characters or symbols on the keypad panel.

Conventional backlight module usually includes a light guide plate and a light emitting device (LED) used to emit light into the light guide plate. Light propagates in the light guide plate and diffuses from a surface of light guide plate to keys of the keypad panel, such that users can clearly identify the numerals, character or symbol printed on the surfaces of keys.

Electronic ink techniques are already employed to electronic display apparatus to show information. The electronic ink material includes a plurality of microcapsules each contains both white and black particles in a microcapsule wall. The electronic ink microcapsules are printed on an electrode substrate, which can generate electrical field to control the behaviors of the white and black particles in the microcapsules. By controlling the behaviors of those colored particles in each microcapsule, it is possible to get macroscopic images from the microcapsules printed on the electrode substrate.

Therefore, the electronic ink techniques seem promising to use in a keypad, thus replacing the numerals, characters and symbols printed on the surfaces of keys. However, since the electronic ink material is not transparent, it cannot employ conventional backlight module for illuminating the electronic ink material to display the numerals, characters or symbols and requires an appropriate accompanying light-source module to compose a practical keypad.

SUMMARY OF THE INVENTION

The present invention is to provide a non-backlighted illuminating keypad, capable of displaying numerals, characters and symbols by controlling the behaviors of colored particles in electronic ink microcapsules. Besides, a light gathering layer is formed above an electronic ink layer to gather light to illuminate the electronic ink layer. Therefore, images formed by electronic ink layer can be clearly viewed by users.

In order to achieve the aforementioned purpose, the present invention provides a non-backlighted illuminating keypad, includes a keypad panel, a light gathering layer, an electronic ink layer, a first elastic layer and a switch board. The keypad panel includes a carrier and a plurality of keycaps arranged on the carrier. The light gathering layer is arranged on a bottom surface of the keypad panel and located corresponding to the keycaps. The electronic ink layer is arranged on a bottom surface of the light gathering layer. The first elastic layer is arranged on a bottom surface of the electronic ink layer and

comprises a plurality of protrusion portions respectively corresponding to the keycaps. The switch board is arranged below the elastic layer.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the invention believed to be novel are set forth with particularity in the appended claims. The invention itself however may be best understood by reference to the following detailed description of the invention, which describes certain exemplary embodiments of the invention, taken in conjunction with the accompanying drawings in which:

FIG. **1** is a perspective view of the keypad of the present invention;

FIG. **2** is a cross-sectional view of the keypad in FIG. **1**;

FIG. **3** is a top view of the keypad in FIG. **1**;

FIG. **4** is a cross-sectional view of the keypad in FIG. **1**;

FIG. **5** is a top view of the keypad in FIG. **1**;

FIGS. **6**(*a*) to **6**(*e*) show different arrangements of a light gathering layer on a bottom surface of a carrier of the present invention;

FIG. **7** is a schematic view showing the present invention being used in a mobile phone;

FIG. **8** is a schematic view showing the present invention being used in a personal digital assistant;

FIG. **9** is a schematic view showing the present invention being used in a car audio system;

FIG. **10** is a schematic view showing the present invention being used in an ultra portable mobile computer;

FIG. **11** is a schematic view showing the present invention being used in a camera;

FIG. **12** is a schematic view showing the present invention being used in a desktop telephone;

FIG. **13** is a cross-sectional view of another embodiment of the keypad of the present invention; and

FIG. **14** is a top view of the keypad in FIG. **13**.

DETAILED DESCRIPTION OF THE INVENTION

A detailed description of the present invention will be made with reference to the accompanying drawings.

As shown in FIGS. **1** and **2**, the keypad according to a preferred embodiment of the present invention includes a keypad panel **1**, a light gathering layer **2**, a first adhesion layer **3**, an electronic ink layer **4**, a second adhesion layer **5**, a first elastic layer **6** and a switch board **7**.

The keypad panel **1** includes a carrier **11** and a keycap layer **13** with a plurality of keycaps **12** arranged on a top surface of the carrier **11**. The carrier **11** is a transparent plastic thin film. The keycaps **12** are made of transparent ultraviolet-curing resin.

The light gathering layer **2** is arranged on the bottom surface of the carrier **11** and is located corresponding to the keycaps **12**. The light gathering layer **2** is made of light gathering ink material.

The first adhesion layer **3** is also arranged on the bottom surface of the carrier **11** where the light gathering layer **2** is not arranged. The first adhesion layer **3** may be adhesive agent or double-sided adhesive tape.

The electronic ink layer **4** is attached on the bottom surface of the carrier **11** by the first adhesion layer **3** and is located below the light gathering layer **2**. The electronic ink layer **4** includes an electrode substrate **41** and an electronic ink material **42** printed on the top surface of the electrode substrate **41**. The electrode substrate **41** includes a plurality of electrode traces (not shown) having patterns such as numerals, charac-

ters and symbols. The electronic ink material **42** includes a plurality of microcapsules (not shown) each having both white and black particles inside. After the electrode traces are electrically charged, the behaviors of particles inside the microcapsules will changed, and then the desired images are formed by the microcapsules of the electronic ink material **42**. Since the electronic ink layer **4** is well known by those of ordinary skill in the art, the details thereof will not be described herein.

The second adhesion layer **5** is arranged on the bottom surface of the electrode substrate **41**. The second adhesion layer **5** may be adhesive agent or double-sided adhesive tape.

The first elastic layer **6** is attached on the bottom surface of the electrode substrate **41** of the electronic ink layer **4** by the second adhesion layer **5**. The first elastic layer **6** includes a plurality of protrusion portions **61** respectively corresponding to the keycaps **12**.

The switch board **7** is arranged below the first elastic layer **6**. The switch board **7** includes a printed circuit board **71** and a second elastic layer **72** arranged on the printed circuit board **71**. The second elastic layer **72** includes a plurality of metal domes **721**. The printed circuit board **71** includes a plurality of electrical contacts **711** corresponding to the metal domes **721**. The switch board **7** also includes a thin film **73** covered on the printed circuit board **71** and the second elastic layer **72**, and a light source **74** electrically connected to the printed circuit board **71**. The thin film **73** includes a plurality of convex portions **731** corresponding to the protrusion portions **61** of the first elastic layer **6**. As FIG. **3** shows, the light source **74** correspondingly located at a lateral side of the carrier **11**. In the present embodiment, the light source **74** is a light emitting diode.

Refer to FIGS. **4** and **5**, when the keycap **12** is pressed by external force, the keycap **12** will downwardly press the light gathering layer **2**, the electronic ink layer **4** and the first elastic layer **6**, and then the protrusion portion **61** of the first elastic layer **6** will press the second elastic layer **72** to contact with the electrical contact **711** of the printed circuit board **71**, and then a connecting signal will be generated for output.

When the light source **74** on the printed circuit board **71** is lighted on, light **8** emitted from the light source **74** enter the carrier **11** from the lateral side thereof. The light **8** is gathered around the light gathering layer **2** to illuminate the adjacent electronic ink material **42**. At the same time, the electrode substrate **41** of the electronic ink layer **4** is electrically charged, the behaviors of particles inside the microcapsules are changed, and then the images of numerals, characters and symbols are formed by the electronic ink material **42**. Therefore, users can clearly identify the pattern of each key and precisely press the right keycap.

Refer to FIGS. **6**(*a*) to **6**(*e*), they show five different arrangements of the light gathering layer of the present invention. The light gathering layer **2** in FIG. **6**(*a*) is arranged according to locations of the keycaps. The light gathering layer **2** in FIG. **6**(*b*) is arranged according to locations of another kind of stripe-like keycaps. Both light gathering layers **2** in FIGS. **6**(*a*) and **6**(*b*) have an obliquely line pattern. The light gathering layer **2** in FIG. **6**(*c*) has a horizontal line pattern. The light gathering layer **2** in FIG. **6**(*d*) printed along outlines of each keycap. The light gathering layer **2** in FIG. **6**(*e*) has only one region covered all the keycaps and has vertical line pattern.

As FIGS. **7** to **12** show, the non-backlighted illuminating keypad of to the present invention can be respectively applied to a mobile phone **10**, a personal digital assistant (PDA) **20**, a car audio system **30**, an ultra portable mobile computer (UMPC) **40**, and a camera **50**, a desktop telephone **60**.

Refer to FIGS. **13** and **14**, in another embodiment of the keypad **1** of the present invention, the electronic ink layer **4** further extend to the display region **701** of portable electronic apparatus **70** to further play a role of display module to show information of the numerals, characters or symbols.

Although the present invention has been described with reference to the foregoing preferred embodiments, it will be understood that the invention is not limited to the details thereof. Various equivalent variations and modifications can still occur to those skilled in this art in view of the teachings of the present invention. Thus, all such variations and equivalent modifications are also embraced within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A non-backlighted illuminating keypad, comprising:

a keypad panel comprising a carrier and a keycap layer with a plurality of keycaps formed on a top surface of the carrier;

a light gathering layer made of light gathering ink material, printed directly on a bottom surface of the carrier and located corresponding to the keycaps;

an electronic ink layer arranged on a bottom surface of the light gathering layer;

a first elastic layer arranged on a bottom surface of the electronic ink layer and comprising a plurality of protrusion portions respectively corresponding to the keycaps; and

a switch board arranged below the first elastic layer.

2. The non-backlighted illuminating keypad according to claim **1**, wherein the carrier is a plastic thin film.

3. The non-backlighted illuminating keypad according to claim **1**, wherein the keycaps are made of ultraviolet-curing resin.

4. The non-backlighted illuminating keypad according to claim **1**, wherein the electronic ink layer comprises an electrode substrate and an electronic ink material printed on the top surface of the electrode substrate.

5. The non-backlighted illuminating keypad according to claim **1**, further comprising a first adhesion layer for attaching the electronic ink layer to the carrier.

6. The non-backlighted illuminating keypad according to claim **5**, wherein the first adhesion layer is adhesive agent or double-sided adhesive tape.

7. The non-backlighted illuminating keypad according to claim **1**, further comprising a second adhesion layer for attaching the first elastic layer to the electronic ink layer.

8. The non-backlighted illuminating keypad according to claim **7**, wherein the second adhesion layer is adhesive agent or double-sided adhesive tape.

9. The non-backlighted illuminating keypad according to claim **1**, wherein the switch board comprises a printed circuit board, a second elastic layer arranged on the printed circuit board and a thin film covered on the printed circuit board and the second elastic layer.

10. The non-backlighted illuminating keypad according to claim **9**, wherein the second elastic layer comprises a plurality of metal domes.

11. The non-backlighted illuminating keypad according to claim **9**, wherein the switch board further comprises a light source electrically connected to the printed circuit board and correspondingly located at a lateral side of the carrier.

12. The non-backlighted illuminating keypad according to claim **11**, wherein the light source is a light emitting diode.

* * * * *